

RESEARCH ARTICLE



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Utilization of Waste Silica and Chitosan as Fertilizer Nano Chisil to Improve Corn Production in Indonesia

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Silica is one of the non essential nutrients which can be found in some materials such as sand, quartz and glass. Silica is also found in waste products that can pollute the environment, even though Si is known as a beneficial element that protects plants from drought and pathogens without damaging the quality of land. For plants that accumulate Si such as the Gramineae, it can increase crop production and also be able to improve the physical properties of plants. Chitosan is a linear polysaccharide polymer that is commercially made from the shells of shrimp, crab and lobster which is a byproduct in the fishing industry so that the availability of raw material is abundant. Therefore, both the materials can be used to be used as fertilizer chitosan and silica (NanoChisil). This study aimed to determine the effects of Nanochisil fertilizers on the increasing growth of corn production in Indonesia. A common result of this analysis was, waste silica and chitosan can be reduced to fertilizer which can be used to reduce the use of NPK fertilizer and manure and can improve the productivity of food crops such as corn.

Keywords: Chitosan, Maze, NanoChisil Fertilizers, Silica.

1. INTRODUCTION

One of the results of the side which could be used as a source of the nutrient elements are rice husk. Based on the reference data,¹ the number of national grain production reached 64 million tonnes. Then assumptions yield husk 20%, then the amount of chaff to be generated can reach 12.8 million tons. Production capacity PT. Tossa Shakti Glass Division reached 25,550 tonnes/year or 70 tons/day production of glass. If the amount of chaff and glass waste that is so abundant is not utilized optimally, then it can cause its own problems in handling and can be turned into an agricultural waste pollutes the environment. Therefore the rice husk containing mostly silica can be used as fertilizer manufacture silica leaves to improve the production of corn plants in Indonesia.

Silica is a component of micro elements required in small quantities by plants. Silica known as a beneficial element that protects plants from drought and pathogen without harming the quality of the land, especially for plants that accumulate Si as in *Gramineae*. This is in accordance with the reference that Si can support healthy growth, prevent plants from the onslaught of illness and cekaman the temperature by means of entry into cells the epidermis of leaves, and then side by side with the Cork cells, so being able to strengthen the tissues of plants.³ Silica

is needed to make the plant order *Gramineae* have leaves that form an upright (not drooping), so that leaves sunlight radiation capture effective and efficient in the use of nutrient N which determine high and low crops.³

Silica in it is used as a fertilizer, or degraded in order not to get carried away by the water float then needs to be coated with a compound that is insoluble in water, i.e. with the addition of Chitosan.⁴

Chitosan is a linear polysaccharide polymers are commercially made from the shells of shrimp, crab and lobster which is a side product in the fishing industry so that the availability of rich raw material.⁵ Chitosan is a natural cationic polymer result of the deasetilasi chitin, an organic compound that is abundant in nature after cellulose. Chitosan has been proven to be non-toxic, biodegradable, and biocompatible bonding agent.⁶ Chitin in Crustacean is in high enough levels to range from 20–60% depending on the species. Currently in Indonesia generated wastes containing chitin around 56,200 tonnes/year.⁷ Same thing with rice husk, chitin is so abundant waste if not utilized optimally, then it can cause problems to become a fisheries waste pollutes the environment. Therefore the waste of chitin and Chitosan can be used as fertilizer and silica leaves manufacture Chitosan to improve maize crop production in Indonesia.

Application of chitosan in agriculture can reduce environmental stress due to drought or nutrient deficiency, increases production and reduces the risk of spoilage. Application of

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Chitosan is also able to increase the chlorophyll so that increases the effectiveness of photosynthesis.⁸ Other benefits of Chitosan can slow down the rate of release of fertilizer nutrients by covering most of the pores so that water can stay signed in to dissolve through the pores which are not enclosed, so chosen coating Chitosan because Chitosan as insoluble in water and is able to overlay the fertilizer.⁹

Nano technology is one way of solving the elements silica and Chitosan into smaller particles. The particle size of the raw materials is reduced to make the fertilizer can be absorbed easily by the membrane of the cells of the leaf so that it is able to improve the quality of the productivity of corn. One of the products the fertilizer applying nano technology and solution of Chitosan and silica fertilizer was NanoChisil. According to Ref. [10], liquid Chitosan fertilizer and silica (NanoChisil) based nanotechnology can be applied to plant the order of *Gramineae* that is rice, sugarcane and corn.

Based on the description of the background, this research aims to know the influence of Nanochisil fertilizer on plant colonization of corn in improving production of corn in Indonesia.

2. EXPERIMENTAL DETAILS

2.1. The Making of NanoChisil Fertilizer

NanoChiSil fertilizer material consists of nanochitosan and nanosilika. As many as 10 grams of chitosan powder material is weighed and dissolved into the 500 ml of 1% acetic acid solution and distirrer for 30 minutes, then filtered to separate the solution of chitosan with dirty's. Nano chitosan synthesized by using 50 ml of diluted liquid chitosan again by adding 200 ml of aquades while stirring constantly using a magnetic stirrer. Chitosan solution is then added to each 20 ml of NaOH solution 0.02% drops to drops while continuing to stir with a magnetic stirrer to chitosan solution changes color to white. Then to know this nanochitosan particle size TEM analysis is done. Creation of materials nanoChiSil (chitosan nano silica) is done by adding as many as 30 ml colloidal nano chitosan into nano-silica colloidal 70 ml (99 Nanosil) while stirring using a magnetic stirrer until homogeneous. Solution of chitosan nano silica generated then analyzed partice's shape and size by using the TEM while their subjects were measured with EDX. The results of the analysis showed that the material already produced nanoChiSil size nanometer.

3. RESULTS AND DISCUSSION

3.1. NanoChisil Fertilizer

NanoChisil fertilizer is derived from Chitosan fertilizer and silica nanoparticles in size made with nanotechnology. Nanotechnology is a technology that resulted from the utilization of the properties of molecules or atomic structure of nanometer-sized.¹¹ Nanoparticles have advantages over similar material in size large (bulk) as the size of nano-particles have a value comparison between surface area and volume of a larger if compared with similar ingredients in large sizes, so the nano-particles are more reactive. Reactivity of the material is determined by the atoms on the surface, because the atoms come into contact directly with other materials.¹² Figure 1 shows that the NanoChisil Fertilizer Product.



Fig. 1. NanoChisil fertilizer product.

3.2. Applications and Benefits of NanoChisil Fertilizer

According to Ref. [10], liquid Chitosan fertilizer and silica-based nanotechnology produced by Dipon Nanotech (Nanosil 99). NanoChisil granting dose is 4 mg/1.5 litres of water. NanoChisil fertilizer can be used combines with leaves fertilizer or with other fertilizers by pouring into the leaves of plants. NanoChisil fertilizer can be applied to crops such as rice, *Graminae* sugarcane and corn. The benefits to the plants with NanoChisil Fertilizer are: can increase the amount and quality of the crops, anti bacterial and anti fungal pathogen, spur germination, increases health and endurance of plants against cekaman, spur growth and accelerate their vegetative leaves, spur and accelerating flowering, fertilization during the generative, plants more resistant to pests and diseases, strengthen the bonds of the cell wall of the plant so that the leaves fruit, flowers, and not loss, urea and reduced to fertilizer pospat up to 50% more doses of a standard per hectare rice fields, reducing the number of plants fell, neutralizes the pH of the soil, the roots of the plant more and longer, and can enhance the process of photosynthesis by optimizing utilization of the sunlight.

The results showed that the growth of corn plants P-27 optimized fertilization treatment contained in 100% organic fertilizer, 25% NanoChisil + 75% of NPK fertilizer and NanoChisil 100% (Unpublished).

Treatment with an organic fertilizer with a concentration 100% has the most good results compared with the control treatment (Unpublished). According to Ref. [13] granting of organic fertilizers not only help growth, but can also serve improve physical properties and biological soil, improve the lives of microorganisms (miniscule remains of bodies) in the soil, improve soil structure so that it becomes even better structures, and improve the chemical properties of the soil due to the power absorption and cation exchange power.

NanoChisil fertilizer 100% shows high yield crops which are also optimized compared to the control treatment (Unpublished). Based on references that Silica accumulates in the tissues of the epidermis formed membrane thick silicon selulosa as a physical barrier to pests and diseases.¹⁴ The granting of the silica also causes the leaves grow stronger and could stretch well without each other's houses, so the process of photosynthesis relative running smoothly.¹⁵ Then the benefits of Chitosan itself can increase antibody induction plant, induces *pytoeleksin* and protein inhibitors contained in lignin.¹⁶ According to Ref. [17] by

the presence of Chitosan, colonization of pathogens in plant tissue can be prevented and if the plant network has been infected, the spread of the pathogen can be limited so that it does not extend to other healthy tissue.

Fertilization NanoChisil 25% + 75% of NPK fertilizer and NanoChisil 100% also have optimal results (Unpublished). That is because the corn plants can grow with optimum levels of NPK elements and the combination of high silica in the least amount of as micro nutrient elements. The granting of the combination nanosilika and NPK fertilizer allegedly capable of making plants more effective in absorbing nutrients. It is known that all plants require the existence of macro and micro nutrient elements for growth.¹⁸

4. CONCLUSION

The conclusions of this research, waste of silica and Chitosan can be reduced into fertilizer which one in use to reduce the use of fertilizers and manure and NPK can increase the productivity of food crops such as corn in Indonesia.

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